

FY 2016 PHASE I AWARD WINNER

FIRM: Entanglement Technologies, Inc.
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AWARD: \$120,000.00
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PRINCIPAL INVESTIGATOR: Dr. Michael Armen
TITLE OF PROJECT: Ethane/Isotopic Methane CRDS Analyzer

SUBTOPIC NUMBER: 8.3.3D

TECHNICAL ABSTRACT:

Entanglement Technologies, Inc. (ET) proposes to develop a gas analyzer for ethane and isotopologues of methane to study of methane sources and sinks, using cavity ring-down spectroscopy (CRDS). Methane is an important contributor to global climate change, and a participant in air pollutant reactions such as ozone. Understanding methane sources, sinks, and transport between them is crucial to predict its effect on climate and pollution. CRDS is an ultra-sensitive and precise optical measurement technique which is already successfully commercially deployed to monitor a wide variety of atmospheric molecules including isotopes of methane. However, these commercial analyzers lack the requisite sensitivity for NOAA research. Other methods to monitor isotopic methane (e.g. multi-pass optical absorption and mid-wave infrared spectroscopy) are difficult to reduce in size and weight for airborne deployment. CRDS can potentially achieve comparable performance with a small gas cell and air pump and short-wave (3 microns) spectroscopy that is easier to implement than 6-8 microns. ET proposes to develop a mid-infrared CRDS analyzer using short-wave spectroscopy to measure ethane concentration to a precision of 10 parts per trillion by volume (pptv), and isotopes of methane with precisions of 0.5% for $^{13}\text{CH}_4/^{12}\text{CH}_4$ and 10% for $^{12}\text{CH}_3\text{D}/^{12}\text{CH}_4$, at 1 Hz measurement rate.

SUMMARY OF ANTICIPATED RESULTS:

The end result after phase II of this project will be a self-contained prototype ethane/isotopic methane analyzer appropriate for laboratory testing. Although the analyzer will operate at 1 Hz measurement rate for the NOAA application, reducing this rate will improve the precision. The analyzer will also be appropriate for commercial applications in natural gas leak detection and forensics, oil and gas exploration, and well lifetime monitoring. Its high precision and $^{12}\text{CH}_3\text{D}$ capability, not currently available in deployed commercial analyzers, will substantially improve the efficiency of the natural gas industry.